

1. The table shows data from five trials of two separate experiments. Which set of values is more precise?

Exp 1 - closest together

2. A series of experiments was carried out to determine the value for a particular quantity. The results are shown in the table. The literature value of this quantity is 47.0 J. Which experiment produced the most accurate value?

1: $47 - 45.276 = 1.724$

2: $|47 - 48| = 1$

3: $47 - 44.2 = 2.8$

4: $|47 - 49.57| = 2.57$

3. Copy and complete the table:

a) $71.5 - 71.9$

b) $3.465 - 3.485$

c) $0.06406 - 0.06606$

d) $58.27 - 68.27$

e) $563.2 - 623.2$

f) $683.28 - 883.28$

4. State the significant figures for each of the following numbers:

a. 2.78

3

b. 0.057

2

c. 0.003480

4

d. 3.95×10^4

3

e. 80.00

4

5. Round each of the following numbers to three significant figures:

a. 6.7863 b. 0.000079835

6.79 0.0000798

c. 0.0049931 d. 8.2457×10^5

0.00499 8.25×10^5

e. 1.78339×10^{-3}

1.78×10^{-3}

6. Copy and complete the table:

a) 0.561 ± 0.003

b) 8.22 ± 0.06

c) 0.0161 ± 0.0006

d) 0.280 ± 0.003

e) 18.30 ± 0.10

7. Copy and complete the table:

a) $\frac{0.2}{27.2} \times 100 = 0.7\%$

b) $\frac{0.007}{0.576} \times 100 = 1\%$

c) $\frac{0.01}{4.46} \times 100 = 0.2\%$

d) $\frac{4 \times 10^{-7}}{7.63 \times 10^{-5}} \times 100 = 0.5\%$

8. A. What is the absolute uncertainty when 2.13 ± 0.01 is multiplied by 4.328 ± 0.005 ? Give the final answer to the appropriate number of significant figures.

$$\bullet \frac{0.01}{2.13} \times 100 = 0.47$$

$$\bullet \frac{0.005}{4.328} \times 100 = 0.16$$

$$\text{total} = 0.6\%$$

$$9.22 \times 0.006 = 0.06$$

$$9.22 (\pm 0.06)$$

- b. What is the absolute uncertainty when 48.93 ± 0.02 is divided by 0.567 ± 0.003 ? Give the final answer to the appropriate number of significant figures.

$$\bullet \frac{0.02}{48.93} \times 100 = 0.04\%$$

$$\bullet \frac{0.003}{0.567} \times 100 = 0.53\%$$

$$\text{tot} = 0.5\%$$

$$86.3 \times 0.005 =$$

$$86.3 \pm 0.4$$

9. Use the equation $E = mc\Delta T$ and the values in the table to calculate the energy released, to the appropriate number of significant figures, when a sample of solution cools:

Mass of Solution (m)	$43.27 \pm 0.01\text{g}$
Temperature Change (ΔT)	22.8 ± 0.2
Specific Heat Capacity (c)	$4.2\text{Jg}^{-1}\text{°C}^{-1}$

$$E = m c \Delta T = 43.27 \times 4.2 \times 22.8 = 4100 \pm 40\text{J}$$

$$g: \frac{0.01}{43.27} \times 100 = 0.02\%$$

$$4144 \times 0.0092 = 40$$

$$\Delta T: \frac{0.2}{22.8} \times 100 = 0.9\%$$

10. Rosie carried out an experiment in which she measured a temperature change. Her data is shown in the table.

Initial Temperature / °C	18.7 ± 0.5
Maximum Temperature / °C	37.6 ± 0.5

The temperature change should be quoted as:

- A. 18.9 ± 0.5 °C C. 18.9 ± 1.0 °C
 B. 19 ± 1 °C D. 19.0 ± 1.0 °C

$$\Delta T = 37.6 - 18.7 = 18.9$$

$$0.5 + 0.5 = 1.0$$

11. Jamal obtained the value 0.002560m^3 from an experiment. The number of significant figures and decimal places is.

- A. 4 significant figures 6 decimal places
 B. 6 significant figures 4 decimal places
 C. 6 significant figures 6 decimal places
 D. 3 significant figures 6 decimal places

12. Molly carried out an experiment to measure the enthalpy change of solution of a salt. In order to calculate a final value, the following calculation was carried out:

$$\frac{[(50 \pm 1) \times 4.2 \times (20 \pm 1)]}{1000 \times (0.10 \pm 0.01)}$$

+/- means plus or minus

$$= 42 \pm 7$$

$$\bullet \frac{1}{50} \times 100 = 2$$

$$\bullet \frac{0.01}{0.10} \times 100 = 10$$

$$\bullet \frac{1}{20} \times 100 = 5$$

$$\text{tot} = 17\%$$

$$42 \times 0.17 = 7$$

Quantities without uncertainties can be assumed to be exact. How should the final value be quoted?

- A. $42 \pm 7 \text{ kJ mol}^{-1}$ C. $42.00 \pm 2.01 \text{ kJ mol}^{-1}$
 B. $42 \pm 2 \text{ kJ mol}^{-1}$ D. $42.1 \pm 7.1 \text{ kJ mol}^{-1}$

Typo

13. Which of the following would be good method for reducing the random uncertainty in an experiment to measure the enthalpy change of neutralization when 50cm^3 of 0.50 mol dm^{-3} sodium hydroxide reacts with 50cm^3 of 0.50 mol dm^{-3} hydrochloric acid?
- A. insulate the reaction vessel with cotton wool
 - B. stir the mixture more rapidly
 - C. repeat the experiment
 - D. measure out the liquids using a 50 cm^3 measure cylinder instead of a burette
14. The graph shows the results of a series of experiments to investigate how the rate of the reaction A \rightarrow B varies with the concentration of A

typo slope = $\frac{\text{rise}}{\text{run}} = \frac{0.8 - 0.4 \text{ mol}}{0.4 - 0.2 \text{ dm}^3 \text{ s}} \times \frac{\text{dm}^3}{\text{mol}} = \text{1/s}$

The slope of this graph is

- A. $2.0\text{ mol dm}^{-3} \text{ s}^{-1}$
- B. 0.5 s
- C. 20 s^{-1}
- D. $0.5\text{ mol}^{-1} \text{ dm}^3$

15. Two separate experimental methods were used to determine the value of a particular quantity. Each experiment was repeated five times. The values obtained from those experiments are shown in the table.

The literature value is 50.9.

a) Explain which set of experimental data is more precise. [2]

Exp 2 is more precise because the measurements are closer together

b) Work out a mean value for each experiment and use this to determine which set of data is more accurate. [3]

mean Exp 1: 51.2
Exp 2: 50.9

Accuracy Exp 1: $51.2 - 50.9 = 0.3$
Exp 2: $50.9 - 50.9 = 0$

16. Lai Ping carried out an experiment to measure a certain quantity. The value she obtained was 56.1 ± 0.5 kJ. This literature value for this quantity is 55.2 kJ
a) Calculate the percent error for this experiment. [1]

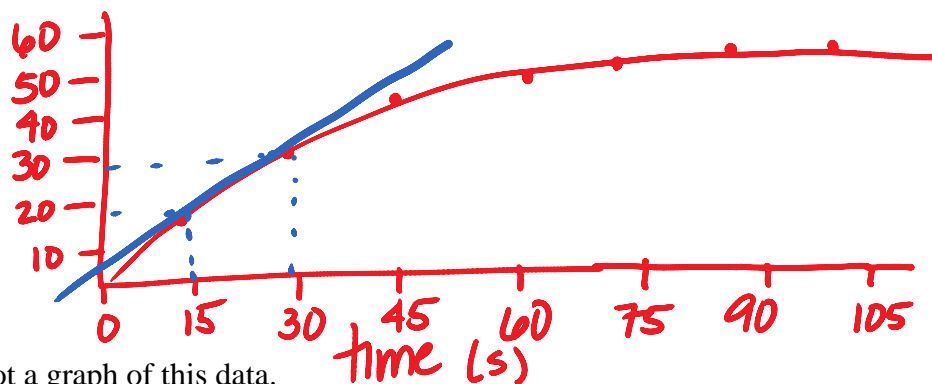
$$\% \text{ error} = \frac{|55.2 - 56.1|}{55.2} \times 100 = 2\%$$

- b) The student maintained that any errors could be explained by random uncertainties. Is she correct? Explain. [2]

- $\% \text{ Uncert} = \frac{0.5}{56.1} \times 100 = 10\%$ from random uncertainties

- so no - 10% must be systematic

17. Tyrone carried out an experiment to measure the rate of the reaction between magnesium and hydrochloric acid. He did this by recording a volume of hydrogen gas every 15 s. The students data is shown below:



- a) Plot a graph of this data.
b) Use your graph to calculate the initial rate of reaction with units.

Initial rate = slope tangent

$$\frac{30 - 20 \text{ cm}^3}{30 - 15 \text{ s}} = 0.7 \text{ cm}^3/\text{s}$$

$$\frac{1}{10} \times 100 = 10\%$$

$$0.7 \times 0.1$$

$$0.7 \pm 0.1 \text{ cm}^3/\text{s}$$